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2 Watermarking a Page Description Language File

3 **Field of the Invention:**

4 The present invention relates to computer technology and more particularly to digital
5 watermarking technology.

6

7 **Background:**

8 A printed page may include graphics, text and images. The graphics, text and
9 images on a page are positioned at specific places on the page to provide a desired
10 effect. A page description language (PDL) is generally used to provide instructions
11 to a printer concerning how the graphics, text and images should be positioned on a
12 page.

13

14 In most situations, an "interpreter" in the printer accepts the instructions provided by
15 the PDL along with the necessary graphic, text and image objects. The interpreter
16 generates appropriate raster image files to position of the ink dots which will form
17 the desired printed page. PostScript™ which was developed by Adobe Systems
18 Corporation is the most widely used PDL; however, there are many other PDLs that
19 have been defined.

20

21 The page layout program PageMaker™ marketed by Adobe Systems Corporation is
22 in widespread use to generate PostScript files. While the PageMaker program is in
23 widespread use there are also are other somewhat similar programs such as those
24 marketed under the trademarks "Quark Express" and "InDesign".

25

26 A number of available interpreters take PostScript files and generate the raster
27 images required by printers. One such interpreter is marketed by Adobe Systems.
28 Another such interpreter is marketed under the trademark "PhonenixPage" by
29 Xionics Document Technologies. Still another PostScript interpreter called

1 "Ghostscript™" is freely available at various internet sites under the "Aladdin
2 Ghostscript Free Public License".
3
4 Programs that can insert digital watermarks into images are in widespread use. For
5 example the widely used image editing program "Photoshop™" includes a
6 mechanism for inserting a watermark into an image.
7

8 **Summary of the Present Invention:**

9 The present invention provides a method and system for watermarking a file which
10 is in a PDL such as PostScript. The present invention can be used to either
11 watermark a PDL file and then generate a watermarked PDL file or the present
12 invention can be part of the interpreter in a printer which takes a file in a PDL and
13 which then generates watermarked raster images which are printed.
14

15 The present invention includes an "interpreter" which generates raster images from
16 the PDL file. The raster images are then watermarked using conventional
17 watermarking techniques. Next the raster images are either printed (if the
18 interpreter is part of a printer) or the raster images are combined into a new PDL
19 file.
20

21 The specific embodiment shown relates to a PostScript file; however, it should be
22 understood that the invention can also be applied to files in other page description
23 languages. PostScript is merely used as an example.
24

25 **Brief Description of Drawings:**

26 Figure 1 is an overall flow diagram of the process.

27 Figure 2 is a flow diagram of the operation that take place in the watermark
28 interpreter.

29 Figure 3 is a block diagram of a PostScript Interpreter.

30 Figure 4 shows a mask which defines areas in an image.

1 Figure 5 is a block diagram of an interpreter.

2

3 **Description of Preferred Embodiment:**

4 The preferred embodiment of the present invention provides a method and system
5 for watermarking a PostScript file. Due to its construction and format, a file in a
6 PDL such as PostScript can not be watermarked using the conventional
7 watermarking programs such as that which is part of the Photoshop program. The
8 preferred embodiment of the present invention is directed to watermarking a
9 PostScript file; however; it should be understood that the invention can also be used
10 to watermark files in various other PDL languages.

11

12 The preferred embodiment utilizes elements from the Ghostscript interpreter. The
13 source code for the Ghostscript interpreter is freely available at various internet web
14 sites under the "Aladdin Ghostscript Free Public License". It should be understood
15 that while the preferred embodiment utilizes the Ghostscript interpreter, the
16 invention can be used with other PostScript interpreters and with other PDLs.

17

18 The overall operation of the invention is illustrated in Figure 1. The process begins
19 as indicated by block 101. A page layout program such as PageMaker is used to
20 generate a PostScript file 103. The page layout program combines text 101A,
21 images 101B and graphics 101C with appropriate instructions and codes, to
22 produce the desired lay out of a page. Such page layout is conventional and it
23 results in a PostScript file 103. The PostScript file 103 is passed to a watermarking
24 interpreter 105 which add an appropriate watermark and then generates a new
25 watermarked PostScript file 106. The details of the watermarking interpreter are
26 described below. Finally PostScript file 106 is provided to a printer which prints the
27 desired page.

28

29 Figure 2 illustrates the operations performed by the watermarking interpreter 105.
30 First the watermarking interpreter generates the appropriate raster images as

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1 indicated by block 201. A conventional interpreter mechanism, such as that
2 available in the Ghostscript interpreter can be used to generate the raster image
3 files. A block diagram of such a mechanism is provided in Figure 5. Next, as
4 indicated by blocks 203 and 204, the areas in each raster image indicated by mask
5 401 (mask 401 is explained later) are watermarked. That is, the bits in the area
6 indicated by mask 401 are watermarked using conventional watermarking
7 technology. Next as indicated by block 205, the watermarked raster images are
8 combined into a new postscript file 207. That is, a simple compiler program adds
9 simple PostScript commands and combines the four raster images into a news
10 PostScript file 207. Creating such a Postscript file from the four raster images uses
11 conventional technology known in the art. Finally the PostScript file 207 is sent to a
12 printer which prints the PostScript file using conventional technology. Naturally the
13 file 207 may be stored on conventional storage mechanisms and electronically
14 transmitted if desired prior to printing.

15

16 As indicated in Figure 3, a printed page may contain a combination of images , text
17 and graphics. The page shown in Figure 3 includes images 302, 303, and 304, text
18 305 and graphics 306 and 307. It should be understood that the page illustrated is
19 merely an example and a page may have a simple or complicated arrangement of
20 text, images and graphics.

21

22 In order to avoid creating visual artifacts, it may be desirable to only watermark
23 selected portions of a page. A mask such as that shown in Figure 4 may be used.
24 In the example shown the mask 401 indicates the areas where a watermarking
25 signal should be applied. It should be understood that mask 401 is not a physical
26 object. It is merely a designation of the areas in a page where a watermark should
27 be applied. That is, areas where the pixels should be “tweaked” in order to apply a
28 watermark to the page. Instead of showing areas where the page should be
29 watermarked, the mask could alternatively show areas that should not be

1 watermarked. The area selected for watermarking are generally areas where the
2 application of a watermark signal will not materially degrade the image.

3

4 The raster image files are watermarked using conventional watermarking
5 technology that specifies how various bits should be changed in order to embed a
6 watermark. For example co-pending application SN 09/694,465 entitled
7 "Watermarking an Image in Color Plane Separations and reading such watermarks"
8 describes technology which could be used to watermark the raster images. The
9 content of application 09/694,465 is hereby incorporated herein by reference.

10

11 Prior to changing any bit in one of the raster images, the mask 401 is interrogated to
12 determine if the particular bit is in a location where it is desired to apply a
13 watermark. If the particular bit is located in the area of mask 401 indicating that the
14 area should be watermarked, the bit is changed, otherwise the bit is not changed.

15

16 A block diagram of the watermarking interpreter 105 is shown in Figure 5. The
17 watermarking interpreter 105 utilizes the well known components of the Ghostscript
18 interpreter. Further details of the Gohstscript interpreter can be found in sources
19 such as the "Ghostscript User Manual" by Thomas Merz (1996-97) which is widely
20 available on the world wide web.

21

22 As indicated in Figure 5 the interpreter takes the graphics 501, the fonts 502, the
23 vectors 503 and the device controls 504 (there also may be other elements) and
24 creates a display list 509. The display list provides information for an image
25 pipeline 511 and a page pipeline 512, The output of pipelines 511 and 512 is the
26 raster image files. In the example illustrated the raster images are CMYK images,
27 515C, 5165M, 515Y and 515K. Naturally in other environments these could be
28 other types of raster images. The publically available source code for the Gostscript
29 interpreter provides a mechanism for implementing the elements shown in Figure 5.

30

1 Each of the raster images 515C to 516K are then watermarked as indicated in
2 Figure 2. This can be done as shown in co-pending application SN 09/694,465
3 entitled "Watermarking an Image in Color Plane Separations and reading such
4 watermarks" which is incorporated herein by reference. These images are only
5 watermarked in the areas indicated by mask 401. The result is four watermarked
6 raster images.

7

8 In the preferred embodiment described above, the four watermarked raster images
9 are combined into a PostScript file as indicated in Figure 1. In an alternate
10 embodiment, the watermarking interpreter is embedded in, and is part of a particular
11 printer. In such an embodiment, the watermarked raster images would be sent
12 directly to the printing mechanism as is conventional. Embedding an interpreter in a
13 printers is conventional. In such a case after the raster images are watermarked,
14 they would be directly printed rather than being combined into another PostScript
15 file.

16

17 It is also noted that in some situations only one raster image is generated and in
18 some situation three, four or more raster images are generated. For example if the
19 colors are RGB, three raster images are generated. In the situations where the
20 printing utilizes hexachrome (i.e. spot colors) there would be six raster images. The
21 term set is used to mean the number of raster images generated for the particular
22 application.

23

24 While the invention has been shown and described with respect to various preferred
25 embodiments, it should be understood that that various changes and alterations can
26 be made without departing from the spirit and scope of the invention. The scope of
27 the invention is limited only by the appended claims.

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29 I claim: